

AD-A106 345

BAKER (MICHAEL) JR INC BEAVER PA

NATIONAL DAM SAFETY PROGRAM, AIRLIE DAM (INVENTORY NUMBER VA 06--ETC(U))

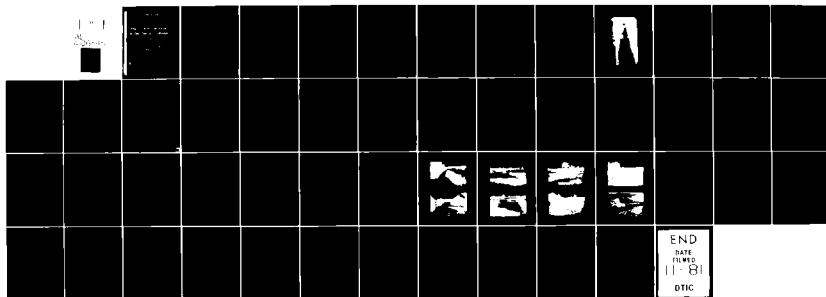
MAY 81 M BAKER

F/G 13/13

DACW65-80-D-0032

NL

UNCLASSIFIED



# RAPPANNOCK RIVER BASIN

Name of Dam: Airtie Dam

LEVEL 1

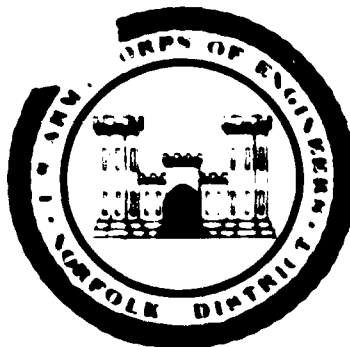
1

Location: Fauquier County, Commonwealth of Virginia

Inventory Number: VA 08115

## PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

AD A106315



DTIC  
OCT 30 1981  
H

DIC FILE COPY

PREPARED FOR  
NORFOLK DISTRICT CORPS OF ENGINEERS  
803 FRONT STREET  
NORFOLK, VIRGINIA 23510

PREPARED BY  
MICHAEL BAKER, JR., INC.  
BEAVER, PENNSYLVANIA 15009

May 1981

81 10 27 302

APPROVED FOR DISTRIBUTION  
Approved for public release  
Distribution Unlimited

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER VA 06115	2. GOVT ACCESSION NO. DA 2284 544	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Airlie Dam Fauquier County, VA		5. TYPE OF REPORT & PERIOD COVERED Final
6. AUTHOR Michael Baker, Jr., Inc. Beaver, Pennsylvania 15009		7. PERFORMING ORG. REPORT NUMBER
8. PERFORMING ORGANIZATION NAME AND ADDRESS Michael Baker, Jr., Inc. Beaver, Pennsylvania 15009		9. CONTRACT OR GRANT NUMBER DACW-65-80-D-000
10. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Engineer District, Norfolk 803 Front St., Norfolk, VA 23510		11. PROGRAM ELEMENT PROJECT TASK AREA & WORK UNIT NUMBERS
12. MONITOR National Dam Safety Program. Airlie Dam (VA 06115). Rappahannock River Basin, Fauquier County, Commonwealth of Virginia. Phase I Inspection Report.		13. REPORT DATE May 81
		14. NUMBER OF PAGES
		15. SECURITY CLASS (of this report) Unclassified
		16. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION Approved for public release; distribution unlimited		
18. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
19. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151		
20. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams VA National Dam Safety Program Phase I Dam Safety Dam Inspection		
21. ABSTRACT (Continue on reverse side if necessary and identify by block number) See Reverse Side)		

# Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Inspection is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspection. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

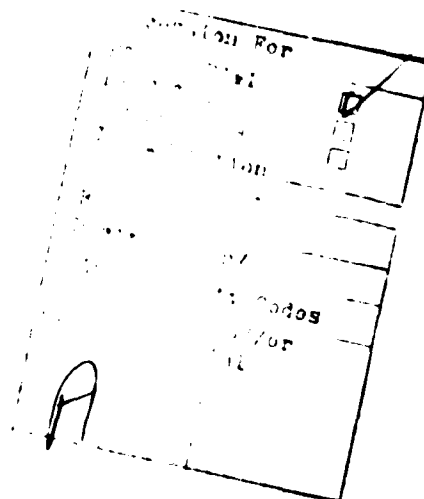
# PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

## CONTENTS

	<u>Page</u>
Preface . . . . .	i
Brief Assessment of Dam . . . . .	1
Overall View of Dam . . . . .	7
Section 1: Project Information . . . . .	9
Section 2: Engineering Data . . . . .	13
Section 3: Visual Inspection . . . . .	15
Section 4: Operational Procedures . . . . .	19
Section 5: Hydraulic/Hydrologic Data . . . . .	21
Section 6: Dam Stability . . . . .	23
Section 7: Assessment/Remedial Measures . . . . .	25

## Appendices

- I. Plates
- II. Photographs
- III. Visual Inspection Check List
- IV. General References



NAME OF DAM: AIRLIE DAM

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Airlie Dam  
State: Commonwealth of Virginia  
County: Fauquier  
USGS 7.5 Minute Quadrangles: Marshall, Virginia  
Stream: Cedar Run  
Date of Inspection: 17 May 1981

BRIEF ASSESSMENT OF DAM

Airlie Dam is an earthfill embankment approximately 24 feet high<sup>1</sup> and 783 feet long. The principal spillway is a rectangular open channel. The emergency spillway, located on the left abutment, is a trapezoidal shaped, grass lined open channel. The dam is located 2.2 miles north of Warrenton, Virginia and is used for recreation. The dam is owned by the Airlie Foundation, Warrenton, Virginia 22186. Airlie Dam is a "small" size - "significant" hazard structure as defined by the Recommended Guidelines for Safety Inspection of Dams. The dam and appurtenant structures were in good overall condition at the time of the inspection. Maintenance of the dam is considered to be adequate. A stability check of the dam is not required.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the spillway design flood (SDF). The spillway is capable of passing up to 61 percent of the SDF or 7 percent of the Probable Maximum Flood (PMF) without overtopping the dam. Overtopping velocities are not considered to be seriously detrimental to the embankment. The spillway is adjudged as inadequate, but not seriously inadequate.

The areas of minor erosion on the upstream face should be monitored. If the erosion continues, it may be necessary to provide erosion protection for the upstream slope.

The wet area downstream from the toe of the embankment should be examined at regular intervals and after periods of heavy rainfall for any signs of increased flow or turbidity. If increased flow or turbidity is noted, a qualified geotechnical engineering firm should be retained to further evaluate this condition.

<sup>1</sup>Measured from the streambed at the downstream toe to the embankment crest.

NAME OF DAM: AIRLIE DAM

Regular inspections should be made of the dam and appurtenant structures. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be completed annually.

A formal warning system and emergency action plan should be developed and implemented as soon as possible.

The following repair items should be accomplished as part of the annual maintenance of the dam:

- 1) Remove all trees and brush from the embankment by cutting them off at ground level. All trees with a diameter greater than 3 inches should also have their root systems removed, and the resultant holes should be backfilled, compacted, and seeded.
- 2) The training walls at the principal spillway entrance should be repaired.
- 3) The voids in the embankment behind the stilling basin training walls should be repaired.
- 4) Debris should be removed from the 12-inch diameter CMP stilling basin outlet.
- 5) Backfill, compact, and seed the eroded areas on the embankment.
- 6) Remove or repair the wooden bridge in the spillway approach channel.
- 7) Install a staff gage to monitor reservoir levels above normal pool.

NAME OF DAM: AIRLIE DAM

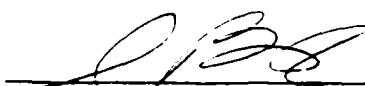


MICHAEL BAKER, JR., INC.

SUBMITTED:

Original signed by:  
Carl S. Anderson, Jr.

Carl S. Anderson, Jr., P.E.  
Acting Chief, Design Branch

  
Michael Baker, III, P.E.  
Chairman of the Board and  
Chief Executive Officer

RECOMMENDED:

Original signed by:  
JAMES A. WALSH

to Jack G. Starr, P.E.  
Chief, Engineering

APPROVED:

Original signed by:  
Ronald E. Hudson

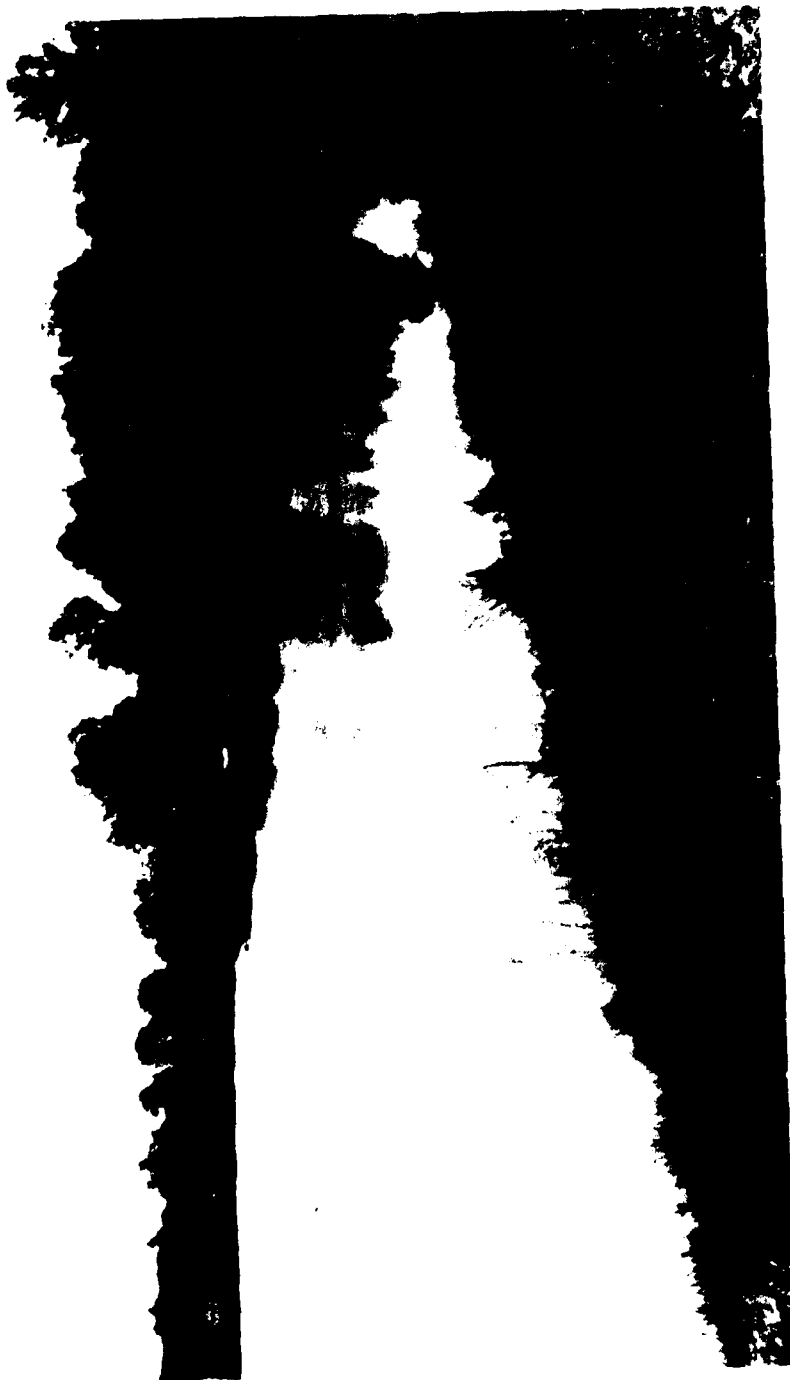
Ronald E. Hudson  
Colonel, Corps of Engineers  
District Engineer



Date:

SEP 11 1981

NAME OF DAM: AIRLIE DAM



OVERALL VIEW OF DAM

PRECEDING PAGE BLANK-NOT FILMED

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
NAME OF DAM: AIRLIE DAM ID# VA 06115

SECTION 1 - PROJECT INFORMATION

1.1 General

- 1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.
- 1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Reference 12, Appendix IV). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

- 1.2.1 Description of Dam and Appurtenances: Airlie Dam is an earthfill embankment approximately 24 feet high<sup>1</sup> and 783 feet long. The crest of the dam varies from 24 feet wide at the abutments to 37 feet wide at the principal spillway. The minimum elevation of the crest is 1003.3 feet Temporary Bench Mark (T.B.M.)<sup>2</sup>. The slope of the upstream face of the embankment is 3.0H:1V (Horizontal to Vertical), and the downstream slope varies from 5.2H:1V to 5.8H:1V. There is no information available on any possible zoning of the embankment. No evidence of an internal drainage system was found. There is no slope protection on the embankment.

<sup>1</sup>Measured from the streambed at the downstream toe to the embankment crest.

<sup>2</sup>All elevations are referenced to a Temporary Bench Mark located on the crest of the principal spillway. The assumed elevation is 1000.0 feet.

NAME OF DAM: AIRLIE DAM

The principal spillway is a 26-foot wide rectangular open channel with a crest elevation of 1000.0 feet T.B.M. The spillway is located in the center of the embankment. At the downstream end of the spillway channel is a 16-foot vertical drop to a large stilling basin. The stilling basin is roughly circular in shape and has cemented masonry training walls. There is a 12-inch CMP at the downstream end of the basin which acts as the stilling basin outlet.

The emergency spillway is located on the left abutment and has a crest elevation of 1002.4 feet T.B.M. The emergency spillway is a trapezoidal shaped, grass lined open channel. The bottom width of the channel is approximately 50 feet.

The reservoir has a 3.88-square mile drainage area to the north and west of the dam. There are several small reservoirs located within the drainage basin. Two dams are located downstream. The first is 2600 feet downstream, and Warrenton Reservoir is approximately 8600 feet downstream.

- 1.2.2 Location: Airlie Dam is located in Fauquier County, Virginia on Cedar Run approximately 2.2 miles north of Warrenton, Virginia. A Location Plan is included with this report in Appendix I.
- 1.2.3 Size Classification: The height of Airlie Dam is 24.0 feet; the reservoir storage capacity at the crest of the dam is 441 acre-feet. The dam is, therefore, in the "small" size category as defined by the Recommended Guidelines for Safety Inspections of Dams.
- 1.2.4 Hazard Classification: Virginia Route 605 crosses the downstream channel over a stone arch bridge approximately 200 feet downstream from the dam. A small reservoir is located 2900 feet downstream, and Warrenton Reservoir is 8600 feet downstream. Loss of human life in the event of a dam failure is not considered highly probable. However, economic losses

NAME OF DAM: AIRLIE DAM

due to damage of Virginia Route 605 and the two downstream dams are likely in the event of a dam failure. Airlie Dam is, therefore, considered to be in the "significant" hazard category as defined by the Recommended Guidelines for Safety Inspections of Dams. The hazard classification used to categorize dams is a function of location only and is not related to stability or probability of failure.

- 1.2.5 Ownership: The dam and reservoir are owned by the Airlie Foundation, Warrenton, Virginia 22186.
- 1.2.6 Purpose of Dam: The reservoir is used for recreational purposes.
- 1.2.7 Design and Construction History: No information on the design or construction history was available for use in this report.
- 1.2.8 Normal Operating Procedures: The reservoir elevation is maintained automatically by the crest of the principal spillway (elevation 1000.0 feet T.B.M.). No formal operating procedures are followed for this structure.

### 1.3 Pertinent Data

- 1.3.1 Drainage Area: The total drainage area tributary to Airlie Dam is 3.88 square miles.
- 1.3.2 Discharge at Dam Site: The maximum discharge is unknown.

Pool level at minimum top of dam:

Principal Spillway . . . . .	481 c.f.s.
Emergency Spillway . . . . .	1761 c.f.s.

- 1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are provided in the following table:

NAME OF DAM: AIRLIE DAM

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation (feet T.B.M.)	Area (acres)	Acre- feet	Reservoir Capacity Watershed (inches)	Length (feet)
Top of dam	1003.3	41.5	441.0	2 13	2320
Emergency spillway	1002.4	36.8	411.0	1 99	2240
Principal spillway crest	1000.0	24.8	335.0	1 62	2160
Streambed at toe	979.3	-	-	-	-

NAME OF DAM AIRLIE DAM

## SECTION 2 - ENGINEERING DATA

- 2.1 Design - Design plans, specifications and boring logs were not available for use in preparing this report. No stability analyses, hydraulic and hydraulic data were available for review.
- 2.2 Construction - Construction records, as-built plans and inspection records were not available for review.
- 2.3 Evaluation - There is insufficient information to evaluate foundation conditions and embankment stability. No design or construction records were available for use in assessing the condition of the dam. All evaluations and assessments in this report were based upon field observations and office analyses.

NAME OF DAM AIRLIE DAM

## SECTION 3 - VISUAL INSPECTION

### 3.1 Findings

- 3.1.1 General: The field inspection was conducted on 17 May 1981. At the time of the inspection, the pool elevation was 1000.4 T B M, the tailwater elevation was 979.8, and the weather was sunny with a temperature of 75 degrees Fahrenheit. The ground surface on the embankment was dry. The dam and appurtenant structures were found to be in good overall condition at the time of inspection. Deficiencies found during the inspection will require remedial treatment. The following are brief summaries of these deficiencies. A Field Sketch of conditions found during the inspection is presented in Appendix I. The complete visual inspection check list is provided in Appendix III. No record was found of any previous inspections.
- 3.1.2 Dam: The embankment was found to be in generally good condition with no surface cracks or slides observed. Erosion was observed at several locations on the embankment. Three small erosion gullies are on the upstream face of the dam near the right abutment. Minor erosion was observed along the entire upstream face of the dam at the normal pool level due to wave action. This erosion is significant in a 50-foot long section of the face near the left abutment where the erosion has created a 0.5-1.0 foot drop in the face of the embankment. The areas on the upstream face of the dam behind the spillway training walls have eroded. A wet area which appears to be the result of poor surface drainage was observed approximately 50 feet downstream from the stilling basin. Flow from this area is approximately 2 g p m. There are several small trees on the embankment crest. There is a 14-inch diameter oak tree on the downstream embankment near the crest, and several other small trees were located on the crest and downstream face of the embankment. An animal burrow was found near the stilling basin.

NAME F DAM AIRLIE DAM



3.1.3 Appurtenant Structures: The principal spillway (as described in Section 1.2.1) was found to be in good condition.

The spillway is a 55-foot long rectangular channel with a concrete and slate bottom and cemented masonry training walls. The upstream section of both training walls at the entrance to the spillway have been separated from the main sections of the walls by a 0.5 inch vertical crack in both walls. The separated sections are approximately 4 feet long.

The reservoir bottom slopes up to the channel entrance. There is a dilapidated wooden foot-bridge across the channel which may restrict flow through the spillway. Flow through the spillway plunges 16 feet to a large stilling basin which is roughly circular in shape. Cemented masonry walls form the basin training walls. The walls are in generally good condition; however, there is flow under the walls in several locations (see field sketch). A concrete slab has been poured along the outside sections of the walls to carry the flow which comes under the walls. Flow under the left section of the wall has created a large void behind the wall which is approximately 3-5 feet deep, 1-3 feet wide, and approximately 6 feet long. There is a 12-inch CMP at the downstream end of the basin which acts as a low level stilling basin outlet. This pipe is clogged.

The approach to the emergency spillway consists of mildly sloping natural ground. The emergency spillway is an earth trapezoidal channel. There is grass cover throughout the channel. An erosion gully has developed in the downstream section of the channel.

3.1.4 Reservoir Area: The reservoir slopes are gentle with good grass cover. Soundings taken at the time of inspection show the water to be 16 feet deep at a distance of 50 feet from the shore near the principal spillway. Sedimentation does not appear to be a serious problem. No significant accumulations of debris were observed around the reservoir

NAME OF DAM: AIRLIE DAM

3.1.5 Downstream Channel: The downstream channel area has gentle to moderate slopes, and is well vegetated and well maintained. The channel passes under Virginia Route 605 through a stone arch bridge. About 2000 feet downstream, the channel enters another lake.

3.1.6 Instrumentation: There was no instrumentation present at the dam.

3.2 Evaluation: In general, the dam and appurtenant structures were in good condition. The 24-inch diameter oak tree and any trees with a trunk diameter greater than 3 inches should be removed from the downstream embankment. Their root systems should be removed and the holes backfilled, compacted, and seeded. All areas of erosion on the embankment should be repaired and erosion protection provided. The animal burrow should be backfilled, compacted, and seeded.

The wet area downstream of the toe of the embankment is probably the result of poor surface drainage and is not considered to be a significant problem at this time. The area should be monitored for seepage in the future.

The spillway training walls should be repaired. The bridge across the spillway approach channel should be repaired or removed. The flow under the stilling basin training walls is not considered to be a serious problem at this time because it is occurring either at the extreme downstream toe of the embankment or beyond the toe. Therefore, this problem is not considered to have a significant impact on the embankment. The void area created behind the left section of the training walls, however, in the downstream face of the embankment should be repaired. The walls should be monitored to ensure that this condition does not become more serious. The outlet pipe from the stilling basin should be unplugged.

A staff gage should be installed to monitor reservoir levels above normal pool.

NAME OF DAM: AIRLIE DAM

#### SECTION 4 - OPERATIONAL PROCEDURES

- 4.1 Procedures: Operation of the dam is an automatic function controlled by the principal spillway and the emergency spillway. Water entering the reservoir flows into the principal spillway at elevation 1000.0 feet T.B.M. When inflow is sufficient to cause the reservoir level to rise above elevation 1002.4 feet T.B.M., discharge takes place through the emergency spillway on the left abutment.
- 4.2 Maintenance of Dam: Maintenance of the dam is the responsibility of the owner. An inspection or maintenance schedule has not been instituted.
- 4.3 Maintenance of Operating Facilities: There are no operating facilities at Airlie Dam.
- 4.4 Warning System: At the time of inspection, there was no warning system or emergency action plan in operation.
- 4.5 Evaluation: Maintenance of the dam in the past has been adequate. Regular inspections of the dam and appurtenant structures should be made and documented. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be corrected annually. A warning system and emergency action plan should be developed and implemented as soon as possible. The plan should include:
- a. How to operate the dam during an emergency.
  - b. Who to notify, including public officials, in case evacuation from the downstream area becomes necessary.

The local Emergency Services Coordinator of the State Office of Energy and Emergency Services can assist in the preparation of an emergency warning plan.

NAME OF DAM: AIRLIE DAM

## SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

- 5.1 Design: No design data were available for use in preparing this report.
- 5.2 Hydrologic Information: No rainfall, stream gage or reservoir stage records are maintained for this dam.
- 5.3 Flood Experience: No records were available.
- 5.4 Flood Potential: The Probable Maximum Flood (PMF), 1/2 Probable Maximum Flood (1/2 PMF), and 100-year flood were developed and routed through the reservoir by use of the HEC-1 DB computer program (Reference 9, Appendix IV) and appropriate unit hydrograph, precipitation and storage-outflow data. Clark's  $T_c$  and R coefficients for the local drainage areas were estimated from basin characteristics. The rainfall applied to the unit hydrograph was taken from publications by the U.S. Weather Bureau and the National Oceanic and Atmospheric Administration (References 16 and 17, Appendix IV). Rainfall losses for the PMF were estimated at an initial loss of 1.0 inches and a constant loss rate of 0.05 inches per hour thereafter. Rainfall losses for the 100-year flood were estimated at an initial loss of 1.5 inches and a constant loss rate of 0.15 inches per hour thereafter.
- 5.5 Reservoir Regulation: Pertinent dam and reservoir data are provided in Table 1.1, Paragraph 1.3.3.

Regulation of flow from the reservoir is primarily automatic. Normal flows are maintained by the crest of the principal spillway at elevation 1000.0 feet T.B.M. Water may also discharge through the emergency spillway on the left abutment when the reservoir rises above an elevation of 1002.4 feet T.B.M.

Outlet discharge capacity was computed by hand. Reservoir area was estimated from the Marshall, Virginia, 7.5 minute USGS quadrangle, and storage capacity curves above normal pools were computed by the HEC-1 DB program. All flood routings were begun with the reservoir at normal pool. Flow through the spillways was included in the routings.

- 5.6 Overtopping Potential: The probable rise of the reservoir and other pertinent information on reservoir performance are shown in the following table:

NAME OF DAM: AIRLIE DAM

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal <sup>1</sup>	100-Year	Hydrographs	
			1/2 PMF	PMF <sup>2</sup>
Peak flow, c.f.s.				
Inflow	2.7	3633.0	9716.0	19,433.0
Outflow	2.7	3421.0	9490.0	19,018.0
Peak elev., ft. T.B.M.	1000.4	1005.4	1007.0	1,008.6
Non-overflow section (elev. 1003.3 ft. T.B.M.)				
Depth of flow, ft.	-	2.1	3.7	5.3
Average velocity, f.p.s. <sup>3</sup>	-	2.6	8.9	11.1
Total duration of over- topping, hrs.	-	4.3	13.3	20.0
Tailwater elev., ft. T.B.M.	979.8	-	-	-

<sup>1</sup>Conditions at time of inspection.

<sup>2</sup>The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in a region.

<sup>3</sup>Velocity estimates were based on critical depth at control section.

5.7 Reservoir Emptying Potential: No means to lower the reservoir below normal pool was observed at the time of the inspection.

5.8 Evaluation: Airlie Dam is a "small" size - "significant" hazard dam requiring evaluation for a spillway design flood (SDF) in the range between the 100-year flood and the 1/2 PMF. Due to the risk involved, the 100-year flood was selected as the SDF. The 100-year flood was routed through the reservoir and found to overtop the dam by a maximum depth of 2.1 feet with an average critical velocity of 2.6 feet per second (f.p.s.). Total duration of dam overtopping would be 4.3 hours. The spillways are capable of passing up to 7 percent of the PMF or 61 percent of the SDF without overtopping the dam.

Conclusions pertain to present day conditions and the effect of future development on the hydrology has not been considered.

NAME OF DAM: AIRLIE DAM

## SECTION 6 - DAM STABILITY

- 6.1 Foundation and Abutments: No information is available on the foundation conditions other than observations made at the time of the inspection. The Geologic Map of Virginia shows the dam is located within the Blue Ridge Province. This particular location is characterized by Metamorphosed Sedimentary Rock of uncertain age. Soil samples taken from the area were found to be orangish brown clayey silt.

No evidence of substantial seepage was observed during the inspection, nor were any problems found associated with piping of the foundation or abutment materials. Based on the visual inspection of the dam, it is believed no internal drainage system for the dam exists. Information on the keying of the dam into the foundation was unavailable.

### 6.2 Embankment

- 6.2.1 Materials: There was no information describing the nature of the materials or any zoning within the embankment. The outer embankment was found to be brown clayey silt with low plasticity. No obvious sources of borrow were discovered in the immediate area of the dam.

- 6.2.2 Stability: Design plans and any previous stability analysis results were unavailable for this inspection. The dam is 24 feet high with a crest width that varies from 24 feet to 37 feet. The upstream and downstream slopes were measured to be 3H:1V and 5.8H:1V, respectively. Beyond the toe of the dam, the natural ground slopes away at a slope of 15H:1V. There are no outlet facilities which provide the capability to drain the reservoir in the event of an emergency. Therefore, the embankment is not considered susceptible to rapid drawdown.

According to the guidelines presented in Design of Small Dams by the U.S. Department of the Interior, Bureau of Reclamation for small homogeneous dams of the described material with stable foundation not subject to rapid drawdown, the recommended slopes are

NAME OF DAM: AIRLIE DAM

3H:1V for the upstream face and 2.5H:1V for the downstream face. The recommended crest width is 13.7 feet. The upstream and downstream slopes and the crest width are all within the guidelines presented.

Visual signs of instability of the dam such as slumping, tension cracks, or unusual alignment along the crest were not observed during the inspection.

- 6.2.3 Seismic Stability: The dam is located in Seismic Zone 2, which presents no great hazard from earthquakes according to the Recommended Guidelines for Safety Inspection of Dams by the Department of the Army, Office of the Chief of Engineers. This recommendation is based upon the fact that static stability conditions are satisfactory, and conventional safety margins exist.

- 6.3 Evaluation: The results of a previous stability analysis were unavailable for review as part of this evaluation. The crest width along with the upstream and downstream slopes are all within the recommended Bureau of Reclamation guidelines. Signs of potential instability were absent during the visual inspection, and a stability check is not required. However, further attention should be given to the various erosion areas located throughout the upstream face. The eroded area behind the stilling basin wall should also be repaired.

Despite the inability of the spillway to pass the SDF, the depth, duration, and rate of overtopping flows are shallow and last only 4.3 hours, and the velocity is less than 6 f.p.s., the effective eroding velocity for a vegetated earth embankment. A stability check is not required.

NAME OF DAM: AIRLIE DAM

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

- 7.1 Dam Assessment: There is insufficient information to evaluate foundation conditions and embankment stability. There were no engineering data available for use in preparing this report. Deficiencies discovered during the field inspection and office analyses require remedial treatment. The dam and appurtenant structures are generally in good overall condition. Maintenance of the dam is considered adequate. A stability check of the dam is not required.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the SDF for the "small" size - "significant" hazard classification of Airlie Dam. The spillways are capable of passing up to 61 percent of the SDF or 7 percent of the PMF without overtopping the dam. The SDF was found to overtop the dam by a maximum depth of 2.1 feet with an average critical velocity of 2.6 feet per second (f.p.s.). Overtopping flows resulting from the SDF are not considered to be seriously detrimental. Therefore, the spillway is adjudged as inadequate, but not seriously inadequate.

There is no warning system or emergency action plan currently in operation.

- 7.2 Recommended Remedial Measures: The areas of minor erosion on the upstream face should be monitored. If the erosion continues, it may be necessary to provide erosion protection for the upstream slope.

Regular inspections should be made of the dam and appurtenant structures. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be completed annually.

The wet area downstream from the toe of the embankment should be examined at regular intervals and after periods of heavy rainfall for any signs of increased flow or turbidity. If increased flow or turbidity is noted, a qualified geotechnical engineering firm should be retained to further evaluate this condition.

A formal warning system and emergency action plan should be developed and implemented as soon as possible.

NAME OF DAM: AIRLIE DAM



The following repair items should be accomplished as part of the general maintenance of the dam:

- 1) Remove all trees and brush from the embankment by cutting them off at ground level. All trees with a diameter greater than 3 inches should also have their root systems removed, and the resultant holes should be backfilled, compacted, and seeded.
- 2) The walls at the principal spillway entrance should be repaired.
- 3) The voids in the embankment behind the stilling basin training walls should be repaired.
- 4) Debris should be removed from the 12-inch diameter CMP stilling basin outlet.
- 5) Backfill, compact, and seed the eroded areas on the embankment.
- 6) Remove or repair the wooden bridge in the spillway approach channel.
- 7) Install a staff gage to monitor reservoir levels above normal pool.

NAME OF DAM: AIRLIE DAM

APPENDIX I

PLATES

## CONTENTS

Location Plan

Plate 1: Field Sketch

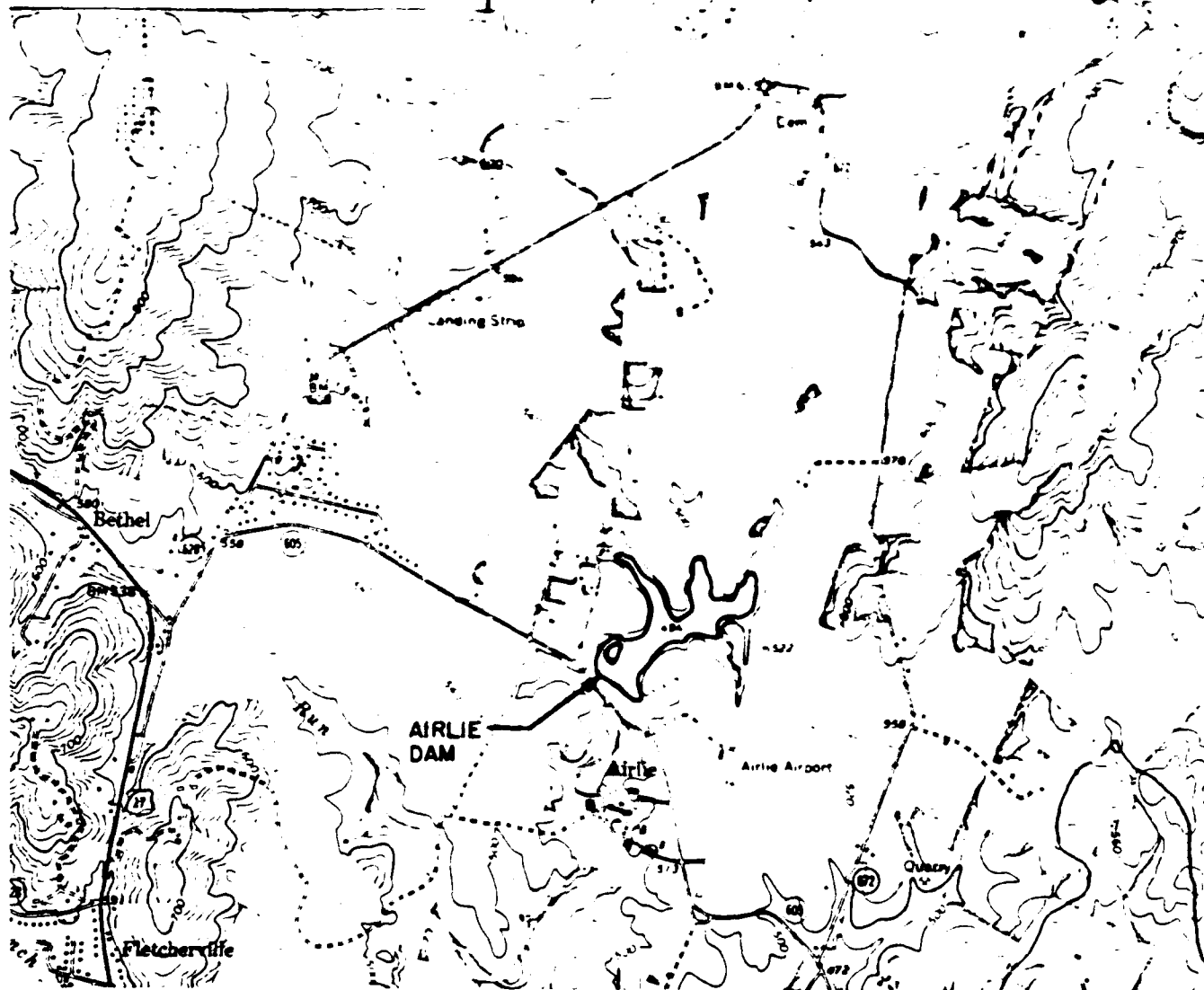
Plate 2: Top of Dam Profile

Plate 3: Typical Cross Sections

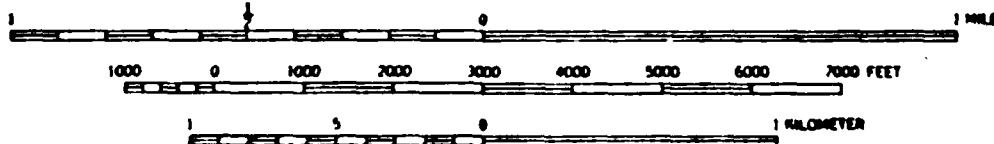
NAME OF DAM: AIRLIE DAM

AIRLIE  
DAM

VA

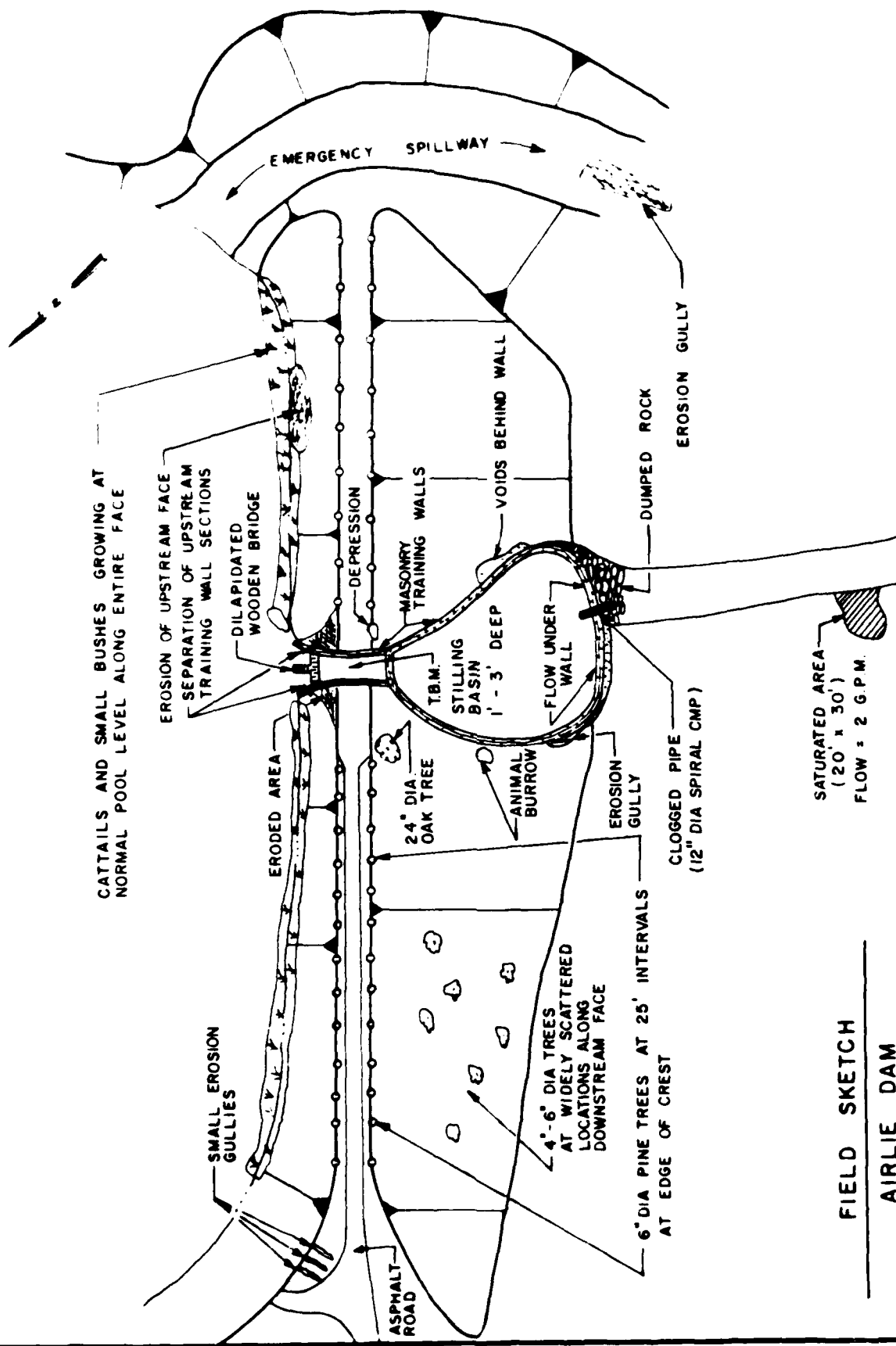


SCALE 1:24000



REFERENCES:  
1. U.S.G.S. 7.5' MARSHALL, VA.  
QUADRANGLE (1970)

LOCATION PLAN  
AIRLIE DAM



FIELD SKETCH

AIRLIE DAM  
17 MAY 1981

RT 605

NO SCALE

MICHAEL BAKER CORP. INC.

THE BAKER ENGINEERS

Box 25  
Houston, Texas 77001

Project No. 100-000000-0000

Sheet No. 1

Drawn by: J. L. Smith

Checked by: J. L. Smith

Sheet No.

Drawing No.

Date

Project No.

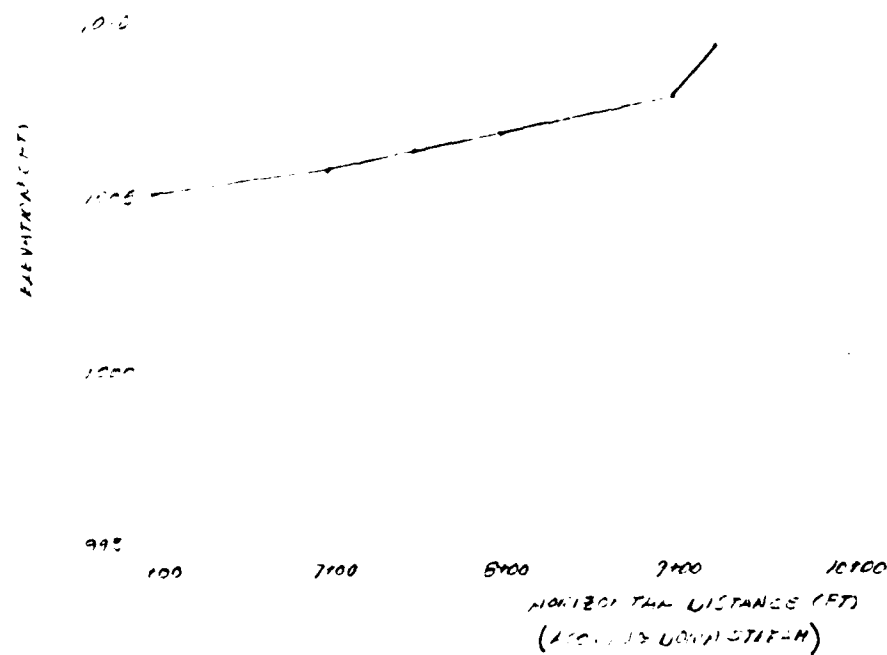
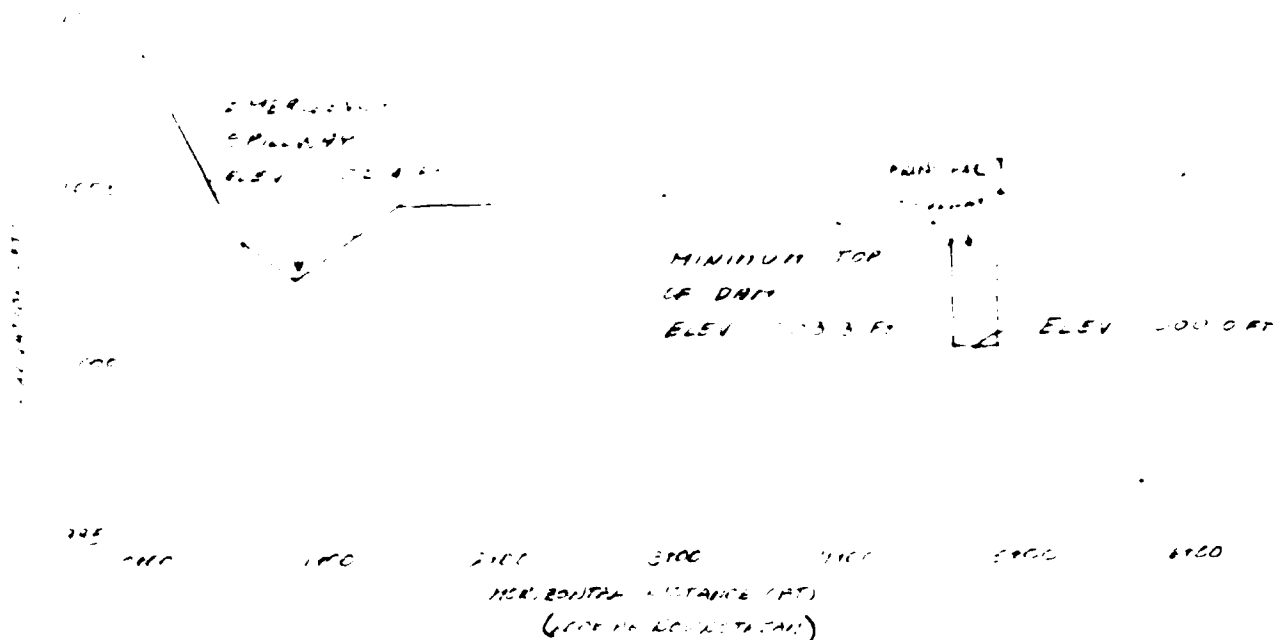


PLATE 2

MICHAEL BAKER, JR., INC.  
THE BAKER ENGINEERS

Box 280  
Houston, Tex. 77001

Subject: *W. A. R. 1000*

*W. A. R. 1000*

*W. A. R. 1000*

Computed by *G. M.*

Checked by *G. M.*

S.O. No.

Sheet No. *1* of *1*

Drawing No.

Date *5/17/51*

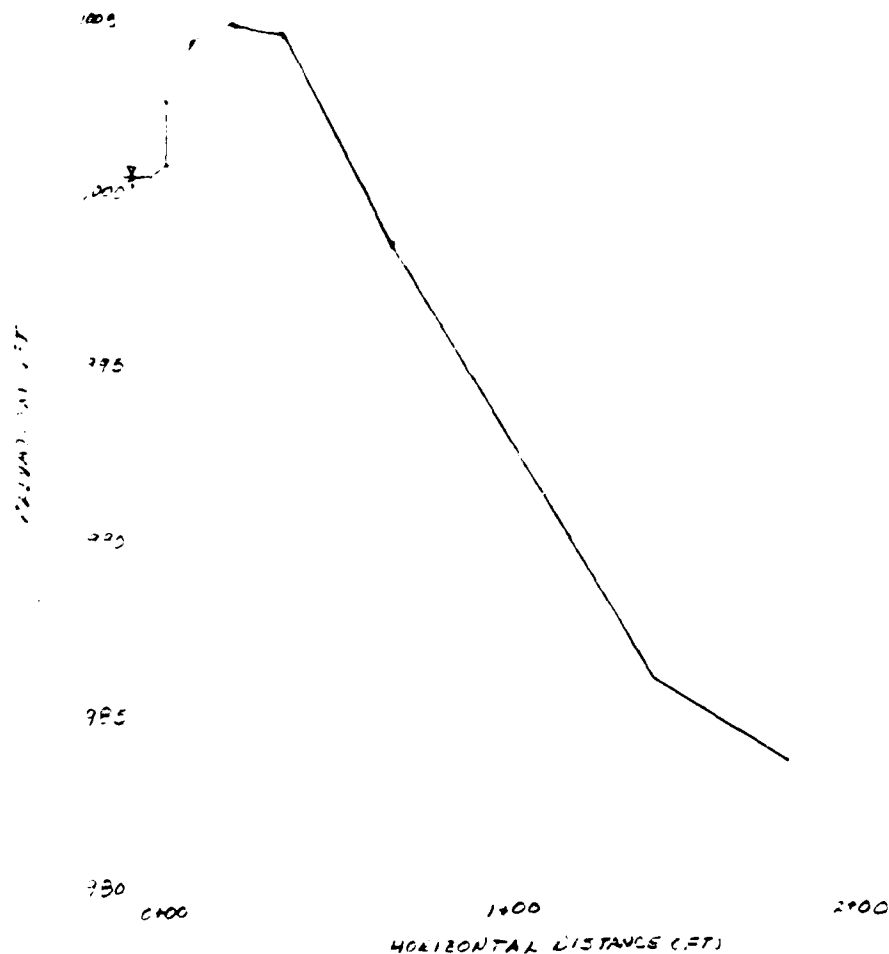


PLATE 3

MICHAEL BAKER, JR., INC.  
THE BAKER ENGINEERS

Box 280  
Beaver, Pa. 15009

Subject: VIRGINIA LANE

PILE CAP

CONCRETE PILE CAP

Computed by

SLA

Checked by

SLT

S.O. No.

Sheet No. 1 of 1

Drawing No.

Date 2/12/68

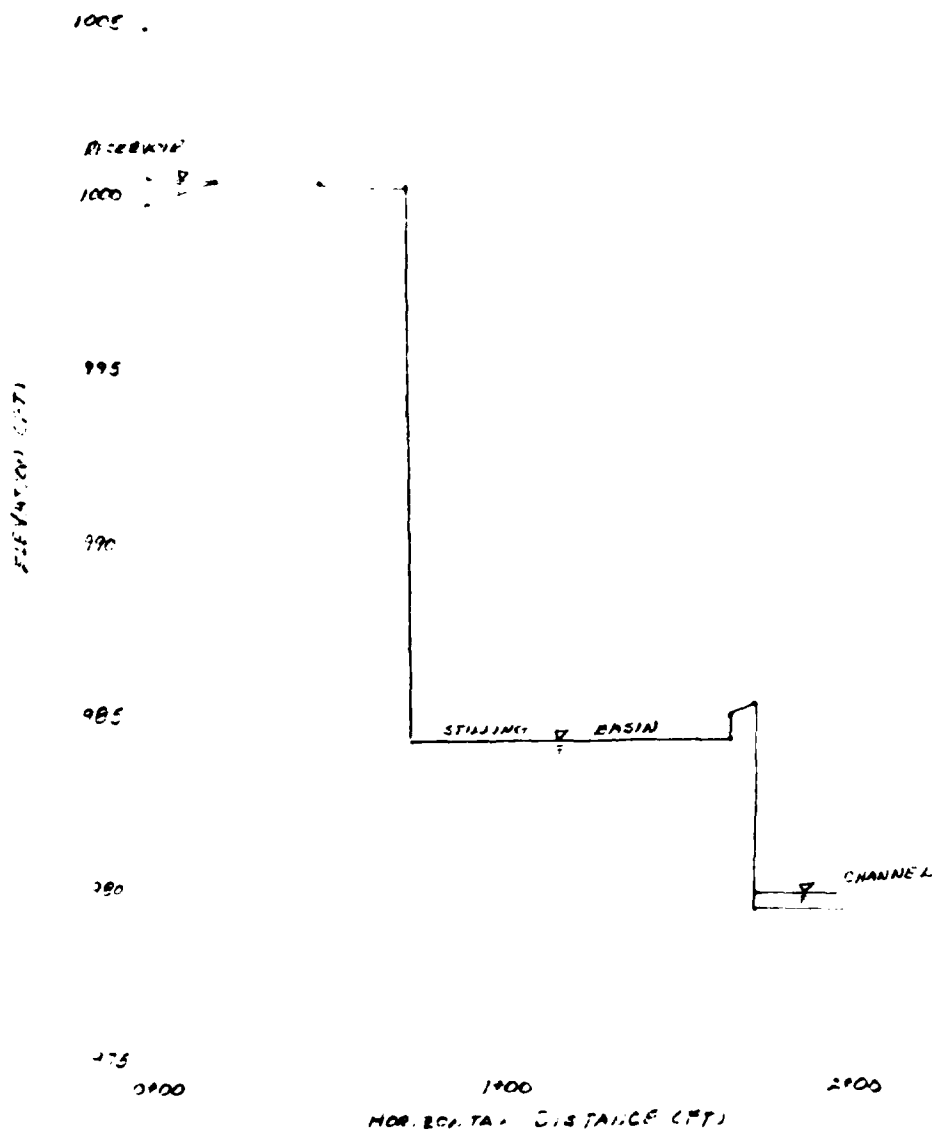


PLATE 3



APPENDIX II  
PHOTOGRAPHS

## CONTENTS

- Photo 1: Upstream Face of Embankment
- Photo 2: View Along Dam Crest
- Photo 3: Downstream Face of Embankment
- Photo 4: Spillway Channel
- Photo 5: Stilling Basin
- Photo 6: Emergency Spillway
- Photo 7: Erosion Gulley in Downstream Section of Emergency Spillway
- Photo 8: Erosion and Flow Under Stilling Basin Training Walls

Note: Photographs were taken on 17 May 1981.

NAME OF DAM: AIRLIE DAM

**AIRLIE DAM**



**PHOTO 1. Upstream Face of Embankment**



**PHOTO 2. View along Dam Crest**

## AIRLIE DAM



PHOTO 3. Downstream Face of Embankment



PHOTO 4. Spillway Channel

**AIRLIE DAM**



**PHOTO 5. Stilling Basin**



**PHOTO 6. Emergency Spillway**

**AIRLIE DAM**



**PHOTO 7. Erosion Gully in Downstream Sections of  
Emergency Spillway**



**PHOTO 8. Erosion and Flow Under Stilling Basin Training  
Walls**

APPENDIX III  
VISUAL INSPECTION CHECK LIST

Check List  
Visual Inspection  
Phase 1

Name of Dam Airlie Dam County Fauquier State Virginia Coordinates Lat. 3847.6  
Long. 7745.6

Date of Inspection 17 May 1981 Weather Sunny Temperature 75OF

Pool Elevation at Time of Inspection 1000.4 T.B.M. Tailwater at Time of Inspection 979.8 T.B.M.

Inspection Personnel:

Michael Baker, Jr., Inc.:

Wayne D. Lasch  
Steve M. Lockington  
Dave W. Miller

Owner's Representatives:

Virginia State Water Control Board

Hugh Gildea

Wayne D. Lasch Recorder



# EMBANKMENT

Name of Dam AIRLIE DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	The ground surface on the embankment was dry. No surface cracks were observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None were observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	<p>Erosion was observed at several locations as described below:</p> <ol style="list-style-type: none"> <li>Three small erosion gullies on the upstream face of the dam near the right abutment</li> <li>At the junctions of the upstream face of the dam and the right and left spillway training wall</li> <li>A minor amount of erosion along the entire upstream face of the dam at normal pool level. This erosion is significant in a 50 -ft. long section of the face near the left abutment where the erosion has created a 0.5 - 1.0 ft. drop in the face of the embankment.</li> </ol>	All areas of erosion should be repaired and erosion protection provided.

# EMBANKMENT

Name of Dam AIRLIE DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

VERTICAL AND HORIZONTAL  
ALIGNMENT OF THE CREST

No problems were observed.

RIPRAP FAILURES

None were observed.

# EMBANKMENT

Name of Dam AIRLIE DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The areas on the upstream face of the dam behind the spillway training walls have eroded. No other problems were observed.	Repair the eroded areas.
ANY NOTICEABLE SEEPAGE	A wet area was observed approximately 20 ft. downstream from the toe of the embankment. Flow from this area is approximately 2 q.p.m. No other problems were observed.	This wet area is probably the result of poor surface drainage and is not considered to be a significant problem at this time. The area should be monitored for seepage in the future.
STAFF GAGE AND RECORDER	There were none.	A staff gage should be installed to monitor reservoir levels above normal pool.
DRAINS	There were none.	

# UNGATED SPILLWAY - PRINCIPAL SPILLWAY

Name of Dam: AIRLIE DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SPILLWAY CHANNEL	<p>The spillway is a 55 ft. long rectangular channel with a concrete and slate bottom and cemented masonry training walls. The upstream section of both training walls at the entrance to the spillway have been separated from the main sections of the walls by a 0.5 in. vertical crack in both walls. The separated sections are approximately 4 ft. long.</p>	<p>The training walls should be repaired.</p>
APPROACH CHANNEL	<p>The reservoir bottom slopes up to the channel entrance. There is a dilapidated wooden footbridge across the channel which may restrict flow through the spillway. No other problems were observed.</p>	<p>The bridge should be repaired or removed.</p>
DISCHARGE CHANNEL	<p>Flow through the spillway plunges 16 ft. to a large stilling basin which is roughly circular in shape. Cemented masonry walls form the basin training walls. The walls are in generally good condition; however, there is flow under the walls in several locations (see field sketch). A concrete slab has been poured along the outside sections of the walls to carry the flow which comes under the walls. Flow under the left section of the wall has created a large void behind the wall which is approximately 3-5 ft. deep, 1-3 ft. wide and approximately 6 ft. long. There is</p> <p>(Continued next page)</p>	<p>The flow under the stilling basin training walls is not considered to be a serious problem at this time because it is occurring beyond the extreme downstream toe of the embankment. Therefore, this problem is not considered to have a significant impact on the embankment. The void area created behind the left section of the training walls is, however, in the downstream face of the embankment and</p> <p>(Continued next page)</p>

Name of Dam: AIRLIE DAM UNGATED SPILLWAY - PRINCIPAL SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DISCHARGE CHANNEL (Continued)	a 12 in. CMP at the downstream end of the basin which acts as a low flow outlet. This pipe is clogged.	should be repaired. The walls should be monitored to ensure that this condition does not become more serious. The outlet pipe from the stilling basin should be unplugged.
BRIDGE AND PIERS	As described above, there is a dilapidated wooden bridge in the spillway.	

# UNGATED SPILLWAY - EMERGENCY SPILLWAY

Name of Dam: AIRLIE DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

## CONCRETE WEIR

Not applicable.

## APPROACH CHANNEL

The approach to the emergency spillway consists of mildly sloping natural ground. No problems were observed.

## DISCHARGE CHANNEL

The emergency spillway is an earth trapezoidal channel. There is grass cover throughout the channel. An erosion gully has developed in the downstream section of the channel.

The erosion gully should be filled and reseeded.

## BRIDGE AND PIERS

None.

# INSTRUMENTATION

Name of Dam: AIRLIE DAM

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
--------------------	--------------	----------------------------

MONUMENTATION/SURVEYS	None were found.	
-----------------------	------------------	--

OBSERVATION WELLS	None were observed.	
-------------------	---------------------	--

WEIRS	None were observed.	
-------	---------------------	--

PIEZOMETERS	None were observed.	
-------------	---------------------	--

OTHER		
-------	--	--

# RESERVOIR

Name of Dam: AIRLIE DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

## SLOPES

The reservoir slopes are gentle with grass cover. No problems were observed.

## SEDIMENTATION

Soundings taken at the time of inspection show the water to be 16 ft. deep at a distance of 50 ft. from the shore near the principal spillway. No significant accumulations of debris were observed around the reservoir.



DOWNSTREAM CHANNEL

Name of Dam: AIRLIE DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No obstructions were observed.	
SLOPES	Gentle to moderate slopes; no problems were observed.	
APPROXIMATE NO. OF HOMES AND POPULATION	There are no homes immediately downstream which are likely to be affected by a failure of the dam.	

APPENDIX IV  
GENERAL REFERENCES

## GENERAL REFERENCES

1. Bureau of Reclamation, U.S. Department of the Interior, Design of Small Dams, A Water Resources Technical Publication, Revised Reprint, 1977.
2. Chow, Ven Te, Handbook of Applied Hydrology, McGraw - Hill Book Company, New York, 1964.
3. Chow, Ven Te, Open Channel Hydraulics, McGraw - Hill Book Company, New York, First Edition, 1959.
4. Commonwealth of Virginia, "Geologic Map of Virginia," Department of Conservation and Economic Development, and Division of Mineral Resources, 1963.
5. HR 33, "Seasonal Variations of Probable Maximum Precipitation, East of the 105th Meridian for Areas 10 to 1000 Square Miles and Durations of 6 to 48 Hours," (1956).
6. King, Horace Williams and Brater, Ernest F., Handbook of Hydraulics, Fifth Edition, McGraw - Hill Book Company, New York, 1963.
7. Soil Conservation Service, "National Engineering Handbook - Section 4, Hydrology," U.S. Department of Agriculture, 1964.
8. Soil Conservation Service, "National Engineering Handbook - Section 5, Hydraulics," U.S. Department of Agriculture.
9. U.S. Army, Hydrologic Engineering Center, "Flood Hydrograph Package (HEC-1), Dam Safety Investigations, Users Manual," Corps of Engineers, Davis, California, September 1978.
10. U.S. Army, Hydrologic Engineering Center, "HEC-2 Water Surface Profiles, Users Manual," Corps of Engineers, Davis, California, October 1973.
11. U.S. Army, "Inventory of United States Dams," Corps of Engineers, 9 September 1978.
12. U.S. Army, Office of the Chief of Engineers, "Appendix D, Recommended Guidelines for Safety Inspection of Dams," National Program of Inspection of Dams, Volume 1, Corps of Engineers, Washington, D.C., May 1975.

NAME OF DAM: AIRLIE DAM

13. U.S. Army, Office of the Chief of Engineers, Engineering Circular EC-1110-2-163 (Draft Engineering Manual), "Spillway and Freeboard Requirements for Dams, Appendix C, Hydrometeorological Criteria and Hyetograph Estimates," (August 1975).
14. U.S. Army, Office of the Chief of Engineers, Engineering Circular EC-1110-2-188, "Engineering and Design, National Program of Inspection of Non-Federal Dams," Corps of Engineers, Washington, D.C., 30 December 1977.
15. U.S. Army, Office of the Chief of Engineers, Engineer Technical Letter No. ETL 1110-2-234, "Engineering and Design, National Program of Inspection of Non-Federal Dams, Review of Spillway Adequacy," Corps of Engineers, Washington, D.C., 10 May 1978.
16. U.S. Department of Commerce, "Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years," Weather Bureau, Washington, D.C., May 1961.
17. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, "Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian," Washington, D.C., June 1978.

NAME OF DAM: AIRLIE DAM

END

DATE  
FILMED

11-81

DTIC